WHAT IS CLAIMED IS:

1. A method for classification of image regions by probabilistic merging of a class probability map and a cluster probability map, said method comprising the steps of:

a) extracting one or more features from an input image composed of image pixels;

b) performing unsupervised learning based on the extracted features to obtain a cluster probability map of the image pixels;

c) performing supervised learning based on the extracted features to obtain a class probability map of the image pixels; and

d) combining the cluster probability map from unsupervised learning and the class probability map from supervised learning to generate a modified class probability map to determine the semantic class of the image regions.

2. The method as claimed in claim 1 wherein the extracted features include color and textual features.

3. The method as claimed in claim 1 wherein the unsupervised learning in step b) comprises the steps of:

determining number of clusters in the input image;

estimating the parameters of a probabilistic model describing the clusters; and

assigning each image pixel to one of the clusters according to the probabilistic model.

4. The method as claimed in claim 1 wherein the supervised learning of step c) comprises the steps of:

creating a labeled training set belonging to a particular class;

determining a number of components required to learn a density function of a given class with the labeled training set as input;

estimating parameters of each density function in a mixture model; and

assigning each image pixel to one of the classes according to the mixture model.

5. The method as claimed in claim 1 wherein the unsupervised learning of step b) comprises the steps of:

determining a number of clusters in the input image using a Kullback-Leibler (KL) divergence method;

estimating mean and covariance parameters of a normally distributed probabilistic model describing the clusters using an Expectation-Maximization (EM) technique; and

assigning each image pixel to one of the clusters according to the normally distributed probabilistic model by computing a posterior probability using Bayes rule.

6. The method as claimed in claim 1 wherein the supervised learning of step c) comprises the steps of:

creating a labeled training set belonging to a particular class;

determining a number of components required to learn a density function of a given class with the labeled training set as input, using a Kullback-Leibler (KL) divergence method;

estimating the mean and covariance parameters of each density function in a Gaussian mixture model using an Expectation-Maximization (EM) technique; and

assigning each image pixel to one of the classes according to the Gaussian mixture model.

7. The method as claimed in claim 1 wherein step d) comprises the steps of:

maximizing a joint likelihood of class and cluster by computing a class conditional probability using Bayes rule;

assigning each of the cluster probability maps to one of the classes according to the class conditional probability; and

computing the modified class probability map by weighting each pixel probability of the class probability map by the corresponding pixel probability of the cluster probability map.

8. The method as claimed in claim 1 wherein step a) comprises the step of extracting and computing low-level features selected from the group including color, texture, shapes, and wavelet coefficients from the input image.

9. The method as claimed in claim 1 wherein step a) comprises the step of detecting and extracting semantic-level features selected from the group including faces, people, and structures from the input image.

10. A computer program product for classification of image regions by probabilistic merging of a class probability map and a cluster probability map comprising: a computer readable storage medium having a computer program stored thereon for performing the steps of:

a) extracting one or more features from an input image composed of image pixels;

b) performing unsupervised learning based on the extracted features to obtain a cluster probability map of the image pixels;

c) performing supervised learning based on the extracted features to obtain a class probability map of the image pixels; and

d) combining the cluster probability map from unsupervised learning and the class probability map from supervised learning to generate a modified class probability map to determine the semantic class of the image regions.

11. The computer program product as claimed in claim 10 wherein the extracted features include color and textual features.

12. The computer program product as claimed in claim 10 wherein the unsupervised learning in step b) comprises the steps of:

determining number of clusters in the input image;

estimating the parameters of a probabilistic model describing the clusters; and

assigning each image pixel to one of the clusters according to the probabilistic model.

13. The computer program product as claimed in claim 10 wherein the supervised learning of step c) comprises the steps of:

creating a labeled training set belonging to a particular class;

determining a number of components required to learn a density function of a given class with the labeled training set as input;

estimating parameters of each density function in a mixture model; and

assigning each image pixel to one of the classes according to the mixture model.

14. The computer program product as claimed in claim 10 wherein the unsupervised learning of step b) comprises the steps of:

determining a number of clusters in the input image using a Kullback-Leibler (KL) divergence method;

estimating mean and covariance parameters of a normally distributed probabilistic model describing the clusters using an Expectation-Maximization (EM) technique; and

assigning each image pixel to one of the clusters according to the normally distributed probabilistic model by computing a posterior probability using Bayes rule.

15. The computer program product as claimed in claim 10 wherein the supervised learning of step c) comprises the steps of:

creating a labeled training set belonging to a particular class;

determining a number of components required to learn a density function of a given class with the labeled training set as input, using a Kullback-Leibler (KL) divergence method;

estimating the mean and covariance parameters of each density function in a Gaussian mixture model using an Expectation-Maximization (EM) technique; and

assigning each image pixel to one of the classes according to the Gaussian mixture model.

16. The computer program product as claimed in claim 10 wherein step d) comprises the steps of:

maximizing a joint likelihood of class and cluster by computing a class conditional probability using Bayes rule;

assigning each of the cluster probability maps to one of the classes according to the class conditional probability; and

computing the modified class probability map by weighting each pixel probability of the class probability map by the corresponding pixel probability of the cluster probability map.

17. The computer program product as claimed in claim 10 wherein step a) comprises the step of extracting and computing low-level features selected from the group including color, texture, shapes, and wavelet coefficients from the input image.

18. The computer program product as claimed in claim 10 wherein step a) comprises the step of detecting and extracting semantic-level features selected from the group including faces, people, and structures from the input image.